Phys 131
Fall 2016

Fundamental Mechanics: Quiz 11

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Formulae:

$\Delta s = r\Delta\theta$ $\omega = \frac{d\theta}{dt}$ $\alpha = \frac{d\omega}{dt}$ $a_t = \alpha r$ $v_t = \omega r$

$\Delta\theta = \omega_i \Delta t + \frac{1}{2}\alpha(\Delta t)^2$ $\omega_f = \omega_i + \alpha\Delta t$ $\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$

$\tau = rF\sin\phi$ $\tau_{\text{net}} = I\alpha$ $K_{\text{trans}} = \frac{1}{2}mv^2$ $K_{\text{rot}} = \frac{1}{2}I\omega^2$

$I = \sum_i m_i r_i^2$ (point masses) $I = MR^2$ (hoop) $I = \frac{1}{2}MR^2$ (disk)

A 4.0 kg solid disk with radius 0.40 m rotates counterclockwise about an axle through its center with angular velocity 50 rad/s. Subsequently a friction force acts at the edge of the disk and brings the disk to a stop in 5.0 s. Determine the magnitude of the friction force.

$I = \frac{1}{2}mr^2$ $R = 0.40\,m$ $M = 40\,kg$

$\tau = I\alpha$

$FR = I\alpha$

$\omega_i = 50$ rad/s

$\omega_f = 0$ rad/s

$\alpha = -10$ rad/s^2

$\omega_f = \omega_i + \alpha\Delta t$

$0 = 50\text{ rad/s} + \alpha(5.0\text{s})$

$-50\text{ rad/s} = \alpha(5.0\text{s})$

$\alpha = -10$ rad/s^2

$\tau = I\alpha$

$FR = (\frac{1}{2}mr^2)\alpha$

$F = \frac{1}{R}(\frac{1}{2}mr^2)\alpha$

$F = \frac{1}{(0.40m)}(\frac{1}{2}(4.0\,kg)(0.40\,m)^2)(-10\text{ rad/s}^2)$

$F = 2.5m(0.32\,kg\cdot m^2)(-10\text{ rad/s})$

$F = -8\,N$

Magnitude of force; $F = 8\,N$